

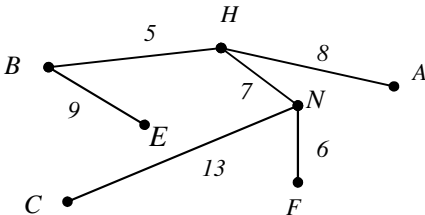
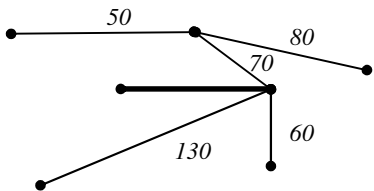
Decision Mathematics D1 (6689)

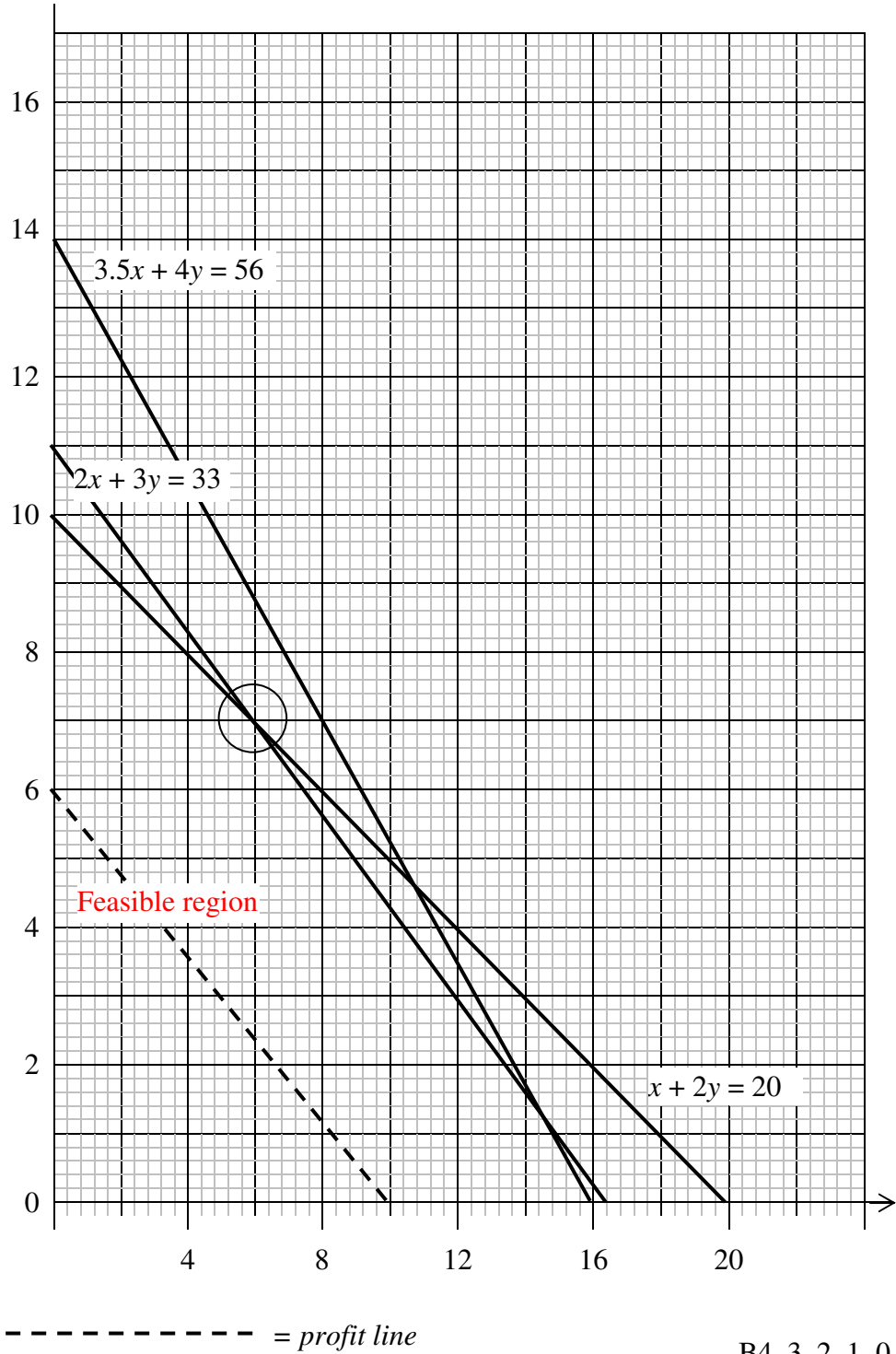
Practice paper B mark scheme

Question number	Scheme	Marks
1.	(a) A graph consisting of <u>two distinct sets of vertices</u> X and Y in which... <u>arcs can only join a vertex in X to a vertex in Y.</u>	B1 B1 (2)
	(b) A path <u>from an unmatched vertex in X to an unmatched vertex</u> in Y... ..which <u>alternately uses arcs in/not in the matching.</u>	B1 B1 (2)
	(c) The (1-1) matching / pairing of <u>some</u> elements of X with elements of Y.	B1 (1)
	(d) A <u>1-1</u> matching between <u>all</u> elements of X onto Y	B1 (1) (6 marks)
2.	(a) To obtain a complete matching the number of vertices on each side must be equal.	B2, 1, 0
	(b) E.g. $L - 3 = H - 5 = J - 1a = A - 4$ c.s. $L = 3 - H = 5 - J = 1a - A = 4$ $A = 4 \quad H = 5 \quad L = 3$ $E = 16 \quad J = 1a \quad M = 2$	M1, A1 A1 (3)
	(c) H and L can now both only do 3. So a complete matching is not possible.	B2,1,0 (2) (7 marks)
3.	(a) $BD + FG = 1.3 + 0.9 = 2.2 *$ $BF + DG = 1.5 + (1.3 + 0.7) = 3.5$ $BG + DF = 0.7 + (0.9 + 0.8) = 2.4$ Repeat BD and FG Route e.g. $GABCDB\overline{FEDB}GFG$ Length = $8.9 + 2.2 = 11.1$ km	M1 A1 A1 (3) B1 M1 A1 (3)
	(b) Only now need to repeat BF of length $1.5 < 2.2$ Length = $8.9 + 1.5 = 10.4$ km saving 0.7 (km)	M1 A1 ft A1 (3) (9 marks)

Question number	Scheme		Marks														
4.	(a)	<p>E.g.</p> <p>Diagram description: A project network diagram with nodes represented by numbers and activities by letters. The start node is marked with an asterisk (*). Activity A leads from the start to node 2. Activity E leads from node 2 to node 5. Activity I leads from node 5 to node 11. Activity D leads from node 2 to the start node (*). Activity C leads from the start node (*) to node 6. Activity J leads from node 6 to node 8. Activity K leads from node 8 to node 11. Activity B leads from the start node (*) to node 4. Activity G leads from node 4 to node 7. Activity L leads from node 7 to node 9. Activity N leads from node 9 to node 10. Activity F leads from node 4 to node 6. Activity H leads from node 6 to node 8. There are dashed arrows from node 8 to node 7 and from node 10 to node 11. Asterisks (*) are at the start node and node 2. Double asterisks (**) are at node 10.</p>	<p>M1 A1 A1 B1 (4)</p>														
	(b)	<p>Reference to K, J, G and L - depends on J and G, but L depends on G only.</p> <p>Both M and N must be uniquely represented in terms of events.</p>	<p>B2, 1, 0</p> <p>B1 (3)</p> <p>(7 marks)</p>														
5.	(a)	<table><thead><tr><th>Left to right</th><th>Right to left</th></tr></thead><tbody><tr><td>55 80 25 84 25 34 17 75 3 5</td><td>55 80 25 84 25 34 17 75 3 5</td></tr><tr><td>80 55 84 25 34 25 75 17 5 3</td><td>84 55 80 25 75 25 34 17 5 3</td></tr><tr><td>80 84 55 34 25 75 25 17 5 3</td><td>84 8 55 75 25 34 25 17 5 3</td></tr><tr><td>84 80 55 34 75 25 25 17 5 3</td><td>84 80 75 55 34 25 25 17 5 3</td></tr><tr><td>84 80 55 75 34 25 25 17 5 3</td><td></td></tr><tr><td>84 80 75 55 34 25 25 17 5 3</td><td></td></tr></tbody></table> <p>Sort complete, no more changes</p>	Left to right	Right to left	55 80 25 84 25 34 17 75 3 5	55 80 25 84 25 34 17 75 3 5	80 55 84 25 34 25 75 17 5 3	84 55 80 25 75 25 34 17 5 3	80 84 55 34 25 75 25 17 5 3	84 8 55 75 25 34 25 17 5 3	84 80 55 34 75 25 25 17 5 3	84 80 75 55 34 25 25 17 5 3	84 80 55 75 34 25 25 17 5 3		84 80 75 55 34 25 25 17 5 3		<p>M1 A1 A1 ft A1 ft</p>
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(b)	$403 \div 100 = 4.03 \therefore 5$ bins	<p>A1 cso (5)</p> <p>M1 A1 (2)</p>															
(c)	<p>Bin 1 84 5 3</p> <p>Bin 2 80 17</p> <p>Bin 3 75 25</p> <p>Bin 4 55 34</p> <p>Bin 5 25</p>	<p>M1 (to 34) A1 A1 (3)</p> <p>(10 marks)</p>															

Question number	Scheme	Marks
6. (a)	A path is a (finite) sequence of edges, such that the end vertex of one edge is the start vertex of the next and in which no vertex appears more than once/ no cycles	B2, 1, 0 (2)
(b)	<p>Shortest path : ABDFGI Length: 108 miles</p>	M1 M1 A1 A1 ft A1 A1 ft (6)
(c)	<p>Eg $108 - 21 = 87$ GI</p> <p> $87 - 15 = 72$ FG <u>OR</u></p> <p> $72 - 21 = 51$ DF</p> <p> $51 - 28 = 23$ BD</p> <p> $23 - 23 = 0$ AB</p> <p>- trace back from I</p> <p>- includes arc xy if y is</p> <p>and if the difference in first labels equals length of arc</p>	
(d)	ABDEFGI Length: 118 miles	M1 A1 (2)
		(12 marks)

Question number	Scheme	Marks
7.	(a)(i) A connected graph with no cycles, loops or multiple edges	B1
	(ii) A tree that includes all vertices	B1
	(iii) A spanning tree of minimum total length	B1 (3)
	(b) E.g. <ul style="list-style-type: none"> In Kruskal the shortest <u>arc</u> is added (unless it completes a cycle), in Prim the nearest unattached <u>vertex</u> is added There is no need to check for cycles when using Prim, but there is when using Kruskal In Prim the tree always “grows” in a connected fashion Kruskal starts with the shortest edge, Prim with any vertex 	B1 (1)
	(c) BH, NF, HN, HA, BE, NC length = 48	M1 A1 B1
		B1 (4)
	(d)  New cable – 390 m	B1 M1 A1 (3) (11 marks)

Question number	Scheme	Marks
8.	(a) $(P =) 300x + 500y$	B1
(b)	Finishing $3.5x + 4y \leq 56 \Rightarrow 7x + 8y \leq 112$ (or equivalent)	B1
	Packing $2x + 4y \leq 40 \Rightarrow x + 2y \leq 20$ (or equivalent)	B1 (3)
(c)	 <p style="text-align: right;">B4, 3, 2, 1, 0 (4)</p>	

Question number	Scheme	Marks
(d)	<i>Point testing:</i> Test corner points in feasible regions Find profit at each and select point yielding maximum <i>Profit line:</i> Draw profits lines Select point on profit line furthest from the origin	B2, 1, 0 (2)
(e)	Using a correct method Make 6 Oxford and 7 York Profit = £5300	M1 A1 A1 (3)
(f)	The line $3.5x + 4y = 49$ passes through (6, 7) So reduce <u>finishing</u> by <u>7</u> hours	M1 A1ft A1 (3)
		(15 marks)